

REVIEW ARTICLE

Associations between children's diet quality and watching television during meal or snack consumption: A systematic review

Amanda Avery  | Catherine Anderson | Fiona McCullough

Division of Nutritional Sciences, School of Biosciences, University of Nottingham, Nottingham, UK

Correspondence

Amanda Avery, Division of Nutritional Sciences, School of Biosciences, University of Nottingham, Sutton Bonington, Nottingham LE12 5RD, UK.
Email: amanda.avery@nottingham.ac.uk

Abstract

Studies have identified an association between watching television (TV) and childhood obesity. This review adds context to existing research by examining the associations between TV viewing, whilst eating, and children's diet quality. Web of Science and PubMed databases were searched from January 2000 to June 2014. Cross-sectional trials of case control or cohort studies, which included baseline data, measuring the associations between eating whilst watching TV and children's food and drink intake. Quality of selected papers was assessed. Thirteen studies, representing 61,674 children aged 1–18 yrs, met inclusion criteria. Of six studies reporting overall food habits, all found a positive association between TV viewing and consumption of pizza, fried foods, sweets, and snacks. Of eight studies looking at fruit and vegetable consumption, seven identified a negative association with eating whilst watching TV ($p < .0001$). Four out of five studies identified a positive association between watching TV whilst eating and servings of sugar-sweetened beverages ($p < .0001$). Four studies identified an association between low socioeconomic status and increased likelihood of eating whilst watching TV ($p \leq .01$). Family meals did not overcome the adverse impact on diet quality of having the TV on at mealtimes. Eating whilst watching television is associated with poorer diet quality among children, including more frequent consumption of sugar-sweetened beverages and high-fat, high-sugar foods and fewer fruits and vegetables. Although these differences in consumption are small, the cumulative effect may contribute to the positive association between eating whilst watching TV and childhood obesity.

KEYWORDS

child public health, childhood diet, childhood obesity, family influences, food consumption, systematic review

1 | INTRODUCTION

The increasing global prevalence of childhood obesity and the associated impact on physical and psychological health have been well documented (WHO, 2016). The foresight report (Government Office for Science, 2007) highlights the complex, multifactorial nature of obesity, with its many contributing factors.

The sedentary lifestyle of children has been implicated in the steady rise in the obesity epidemic (Health Survey for England, 2014), and television (TV) viewing has been positively associated with increased body mass index (BMI) in children (Braithwaite et al., 2013; Montoye et al., 2013). It has been commonly hypothesised that

increased TV viewing replaces hours spent undertaking physical activity, thereby leading to reduced energy expenditure and subsequent weight gain (Dietz, 2001). Conversely, research has shown that this might not necessarily be the case and that the increased weight associated with higher rates of TV viewing are, in fact, unrelated to physical activity or lack thereof, but due to other factors (Biddle, Gorely, Marshall, Murdey, & Cameron, 2004).

Alternative ways in which TV viewing has been linked to increased weight in children is through the influence that it has on children's diet in terms of advertising energy-dense food (Andreyeve, Kelly, & Harris, 2011), promoting mindless eating during viewing, (Ogden et al., 2013) and increased snacking and "junk food" consumption, (Boulos, Vikra,

Oppenheimer, Chang, & Kanarek, 2012), including higher consumption of sugary drinks (Carson & Janssen, 2012; Dubois, Farmer, Girard, & Peterson, 2008). The role of parents should be taken into account when considering these factors, because their influence shapes children's food habits from a young age (Francis, Lee, & Birch, 2003; Olafsdottir et al., 2014), and parents' ability to set rules regarding limits on time spent watching TV could prove of importance in influencing their child's diet quality (Anderson & Whitaker, 2010). Associations have previously been confirmed between socioeconomic status (SES) and childhood obesity (Stamatakis, Wardle, & Cole, 2010), but it is less clear how watching TV and diet quality are influenced by low SES.

Although many studies have examined associations between TV viewing and obesity in children, there are limited data investigating the associations between TV viewing and the foods and drinks, which are consumed during this time. This review examines the associations between watching TV during meal or snack consumption and children's diet quality. Despite living in an age of multiple electronic screen devices, this review focuses on the hardware TV, located in the home setting, but will include commercial and noncommercial TV, videos, and DVDs without differentiating between them.

2 | METHODS

2.1 | Search strategy and selection criteria

To ensure that no similar reviews had already been published, we conducted a preliminary computerised search of the Cochrane Library. One review (Wahi, Parkin, Beyenne, Uleryk, & Birken, 2011) was not specific to the effects of interventions on diet quality. A second search of Web of Science also returned one review, entitled *ObesityTV: How TV is influencing the obesity epidemic* (Boulos et al., 2012).

Results from cross-sectional studies dating from January 2000 to July 2014 were reviewed by performing further computerised searches of Web of Science and PubMed (MED-LINE) using the search terms "family or meal", "tele* or TV," and "obesity or BMI or food choices or obese or overweight." Filters were used to eliminate nonhuman studies and those that were not in the English language, as well as studies based on adults. A title screen, followed by abstract screen, was performed in order to exclude nonrelevant studies. The remaining studies were then read and assessed against inclusion or exclusion criteria by all three researchers. A hand-search of included studies was performed, and relevant articles assessed in order to produce the final list of studies to be included. This final list was checked by

two reviewers before data extraction. A PRISMA checklist was followed (Liberati et al., 2009).

Inclusion criteria:

- Study participants: children ≤ 18 years
- Studies examining the associations between watching TV whilst eating or drinking in developed countries and diet quality
- Articles in English language

Exclusion criteria:

- Data based on follow-up data from longitudinal studies where other variables may have influenced food and drink intake
- Reviews, rather than original data
- Studies including an intervention

The primary outcome was the association between eating during TV viewing and children's food and drink consumption. The secondary outcomes were the effect of eating during TV viewing on BMI and risk of overweight, role of parents, socioeconomic influences, and associated physical activity levels.

2.2 | Data collection and extraction

Data extraction included authors, year, and country; type of study; method of determining amount of TV viewing during food or drink consumption; method of determining dietary intake or patterns; outcomes reported; adjustment for confounding variables; and key findings.

2.3 | Quality assessment

The quality of the studies was assessed by two reviewers, independently, using an amended version of the Newcastle–Ottawa scale (Higgins & Green, 2011), in which stars were awarded for high quality characteristics, as shown in Table 1. This adapted version allowed a maximum score of two for each category. Given that multiple factors can influence food intake, high scores reflect that there has been adjustment for confounding factors—particularly SES.

3 | RESULTS

Forty-six studies were originally identified that measured the associations between watching TV on food intake and obesity in children.

Key Messages

- Eating whilst watching TV is associated with poorer diet quality among children.
- This reduced diet quality includes more frequent consumption of sugar-sweetened beverages, more high-fat/high-sugar foods and fewer vegetables and fruit.
- Although the differences in diet quality are small, the cumulative effect may contribute to the positive association between eating whilst watching TV and childhood obesity.
- An association between low-socioeconomic status and the increased likelihood of eating whilst watching TV was observed.

TABLE 1 Assessment of quality of a cohort study—Newcastle–Ottawa scale

Selection	
1. Representativeness of the study population	
a. Truly representative of the children in the contemporary western world	
b. Somewhat representative of the children in the contemporary western world	
c. Selected group of children (e.g., only certain socioeconomic groups or areas)	
d. No description of the derivation of the cohort	
2. Ascertainment of exposure	
a. Measurement by trained health professional	
b. Use of validator tool, for example, previously validated questionnaire	
c. Written self-report	
d. Other or no description	
Comparability	
1. Comparability of cohorts on the basis of the design or analysis	
a. Study controls for socioeconomic status (or measure of)	
b. Study controls for other factors, for example, maternal education, child's gender, age, and ethnicity	
c. No control	
Outcome	
1. Assessment of outcome	
a. Multiple regression analysis controlling for mediators	
b. Self-report	
c. Other or no description	
2. Was period over which data was collected appropriate for outcomes to be measured?	
a. Yes, if data was collected on >1 occasion, including one weekend day and one week day	
b. No, if data was collected on a single occasion or did not include one weekend day and one week day.	

Twenty-six studies were omitted because they included an intervention, were based on longitudinal study data, or were not presented in English language. Seven studies were excluded because they did not report associations between watching TV during food or drink consumption (Figure 1).

Table 2 presents the reported associations between watching TV during food consumption and children's food and drink intake (13 studies).

3.1 | Quality assessment

Results from the quality assessment are summarised in Table 3. Nine out of the thirteen papers achieved a score of 5 out of a maximum possible of 6.

3.2 | Study characteristics

Total number of children included in the 13 studies was 61,647, all of whom were aged between 1 and 18 years. Of these, 24,141 children were aged ≤ 11.5 years. The remaining 37,506 were aged 11–18. Some overlap occurred due to children being surveyed according to their school year, rather than age, and different studies targeted children according to different cutoff ages. Of the 24,141 children aged ≤ 11.5 years, 3,011 children could be considered of preschool age (≤ 6 years). Five thousand nine hundred eighty-six children were of primary school age (6–11.5 years). The study by Lissner et al. (2012) (not included in this figure) used data from the European funded identification and prevention of dietary- and lifestyle-induced health effects in childhood and infants study, which was based on children aged 2–9 years.

The total sample comprised 35,650 girls and 35,068 boys. A further 4,966 children were included in the study by Liang, Kuhle, and Veugeliers (2009), which gave no details of gender. The study by Coon, Goldberg, Rogers, and Tucker (2001) only interviews 91 parent–child pairs; however, its results are consistent with the results of the larger studies.

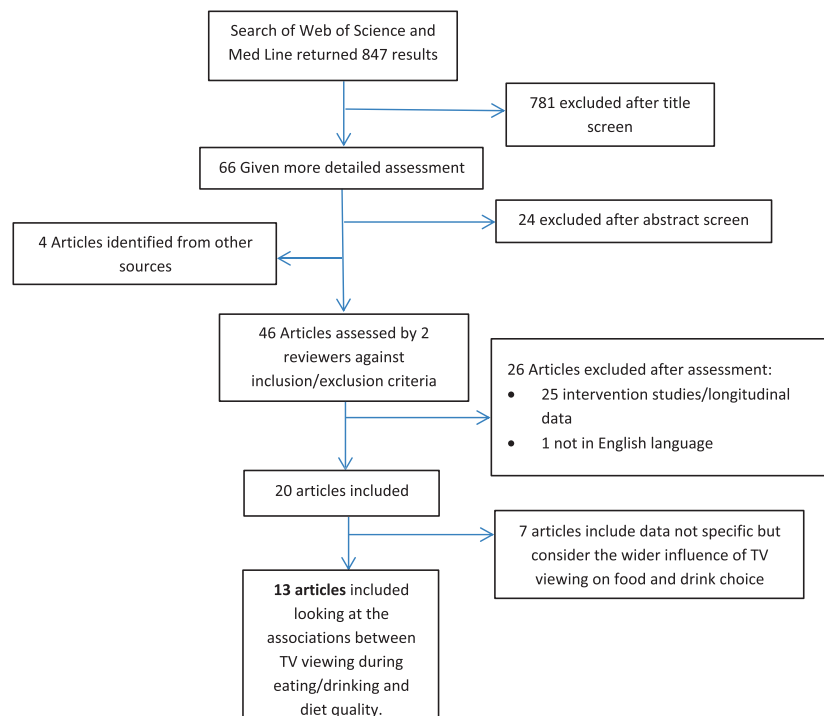


FIGURE 1 Flow diagram showing database search results

TABLE 2 Associations between children's diet quality and watching television during meals or snacks

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Carson and Janssen, 2012 Canada (11)	N = 15,973 Canadian children in grades 6–10 (12.8–15.3 years, mean age 14.4 years) who participated in the health behaviour in school-aged children survey. (N = 8242 females and 7731 males)	Analysis of Canadian only data collected from WHO-sponsored HSBC cross-sectional survey conducted in over 40 countries in 2009/2010.	Classroom-based questionnaire	Classroom-based questionnaire	Whether TV snacking and junk food consumption mediate the relationship between TV viewing and BMI.	Gender, age, race, family structure, and SES, whether currently dieting and whether dieting in the last 12 months.	Snacking and junk food consumption increased with increasing time spent viewing. By comparison with TV viewing quartile 1, frequency of TV snacking was 0.65 (95% CI [0.57, 0.74]) units higher in quartile 2, 0.92 (95% CI [0.84, 1.01]) units higher in quartile 3 and 1.35 (95% CI [1.26, 1.45]) units higher in quartile 4. Frequency of junk food consumption was higher in quartile 2 (0.19; 95% CI [0.13, 0.24]), quartile 3 (0.37; 95% CI [0.31, 0.42]), and quartile 4 (0.61; 95% CI 0.55, 0.67). BMI increased with increased time spent watching TV ($p \leq .05$). For every 1 unit increase in the 7 point TV snacking scale, the BMI z-scores decreased by 0.03 ($p < .05$)
Coon et al., 2001 USA (26)	N = 91 parent-child pairs, with children in the 4th, 5th or 6th grade. (9–12 yrs). Mean age was 10 years. (N = 53 females and 38 males)	Data collected from Maryland suburbs from 1993–1995 as part of a study on family behaviours and children's diets	Face-to-face interview, structured survey in family home. Qu re; whether TV on or off during each meal	three nonconsecutive 24-hr. recalls: school days	Energy intake: %energy CHO and % energy total fat snacking	Parents' nutritional knowledge, attitudes and norms, mother's education (years in school), hours per week mother works for pay, number of meals per day TV is on, number of nights per week parents prepare quick suppers, and parent's attitude toward meat.	TV is more likely to be on during meals in families with lower incomes ($p \leq .01$) and less-educated mothers ($p \leq .05$). Compared with children from families in which the TV is on for <2 meals per day, children from families where the TV is on for >2 meals per day

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Cox et al., 2012. Australia (23)	N = 135 preschool children aged 2–6 years (mean age: 4.5 years) from Melbourne (N = 81 females and 54 males)	Data collected from cross-sectional survey between Jun–Sep 2010.	3-day TV diary completed by mothers of pre-schoolers. Information collected on viewing time, content and food consumed whilst watching TV.	3-day TV diary completed by mothers of preschoolers. Information collected on viewing time, content and food consumed whilst watching TV.	Association between BMI and TV viewing time, TV content, energy intake whilst viewing and daily physical activity.	Moderate positive association between TV viewing and energy intake whilst viewing TV on weekdays and weekends ($r = 0.61$ and 0.50 , $p = .001$). Weak positive associations were found between TV viewing and consumption of obesogenic foods ($r = 0.23$, $p = .001$) and frequency of consuming fast foods ($r = 0.27$, $p = .001$). Daily serves of vegetables was moderately negatively associated with TV viewing ($r = -0.31$, $p = .001$). Weak association between weekday and weekend TV viewing and number of minutes in	consumed 1. 16% fewer vegetables per day ($p \leq .01$) 2. 15% more portions of soda per day ($p \leq .05$) 3. 2% more of their total daily energy from meat ($p \leq .05$), with 14% more red meat per day ($p \leq .01$) 4. 3% more of their total daily energy from pizza, salty snacks, and sodas combined ($p \leq .001$) 5. 2% less of their total daily energy intake from fruits, vegetables, and juices combined ($p \leq .001$). 6. Twice as much caffeine ($p \leq .05$).

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Del Mar Bibiloni et al., 2009 Spain (30)	N = 1 231. 12–17-year-old children living in the Balearic Islands (N = 657 females and 574 males)	Population-based cross-sectional nutritional survey carried out in the Balearic Islands between 2007 and 2008.	General questionnaire with question about distraction during meals—one option being watching TV, as well as questions regarding hours per day of TV viewing.	Two nonconsecutive 24-hr diet recalls General questionnaire with questions about frequency of eating specific foods and number of daily meals.	Prevalence of overweight, differences between genders, waist hip ratio and body fat measurements. Link between obesity, parental education and meals per day. Link between TV and SSB	Sociodemographic and lifestyle variables.	sedentary activities ($r = 0.20$ and 0.22 , respectively, $p = .05$). Positive correlation between watching TV and SSB consumption ($r = 0.123$, $p < .001$). Positive association between BMI and distraction at mealtimes (OR 1.52, 95% CI [0.81, 2.84]) but not significant. Inverse relationship between parental education and BMI (OR: 3.47 in boys, 95% CI [1.58, 7.62] and 3.29 in girls, 95% CI [1.38, 7.89], $p < .01$). Increasing risk of obesity with decreasing number of meals per day (adjusted OR: 2.60 in boys who ate 4 meals per day, 95% CI [1.13, 5.98], $p < .05$ and 4.99 in boys and 2.20 in girls who ate 1–3 meals per day, 95% CIs [2.1, 11.54] and [0.99, 4.89], respectively, $p < .01$) Risk of obesity linked to parental education (adjusted OR: 2.35 boys and 1.89 girls with parents of medium education level, 95% CIs [1.04, 5.34] and [0.73, 4.94], respectively $p < .05$ and 3.47 boys and 3.29 girls from parents with low educational level, 95% CIs [1.58, 7.62] and [1.38, 7.89], respectively, $p < .01$).

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Dubois et al., 2008 Canada. (12)	N = 1,540 representative sample of children born in 1998 (aged 4–5 years) in Quebec, Canada. (N = 750 females and 790 males)	Analysis of baseline data from longitudinal study of child development in Quebec (1998–2002).	TV viewing questionnaire	24-hr recall, eating behaviour questionnaire	Association between eating meals and snacks in front of the TV and: • BMI • energy intake • macronutrient intake • consumption of fruit or veg • consumption of soft drinks • hours of viewing	Maternal characteristics (age, immigrant status, education, working status and self-perceived health). Mother and father's smoking status, and derived number of smoking parents in the household, family type, household annual income, SE status. Variables pertaining to the child including day care attendance and sex of the child.	Children who ate snacks whilst watching TV every day consumed more CHO and less energy from proteins compared with children who never ate snacks in front of the TV ($p \leq .05$). Eating meals during TV viewing once daily or more was associated with lower consumption of energy from protein ($p \leq .05$). Eating dinner or snacks daily whilst watching TV was associated with fewer servings of fruits & vegetables ($p \leq .05$). Eating meals whilst watching TV increased odds of drinking soft drinks daily (OR: 2.316, $p < .0001$). Having snacks whilst watching TV increased the odds of drinking soft drinks (OR: 2.294, $p < .0001$) & increased further for children who ate snacks whilst watching TV daily (OR: 3.568, $p < .0001$). Children who ate in front of the TV once daily had 70% increased odds of drinking soft drinks daily, which increased to 80% in children who ate in front of the TV twice daily. Children who ate snacks or dinner whilst watching TV once daily or more had higher BMI compared to those who did so less than once

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Feldman et al., 2007 USA (27)	N = 4064 ethnically and socioeconomically diverse adolescents from 31 public middle and high schools in Minneapolis-St. Paul metropolitan area. Mean age 14.9 years (range from 11 to 18) (N = 2,022 females and 2,042 males)	Cross-sectional study –data from project Eating Among Teens (EAT) collected in 1998–1999.	Project EAT survey	149-item youth or adolescent questionnaire	Intake of fruits, total vegetables, dark green or yellow vegetables, calcium-rich food, grains, soft drinks, fried food, snack food, calories, family meal frequency, and watching TV during meals.	Socio-demographics, weekly hours spent watching TV, and caloric intake	Boys and girls who ate family meals whilst watching TV ate fewer vegetables, including dark green or yellow vegetables, and calcium rich foods and more soft drinks than those who ate family meals without TV ($p < .001$) Fewer grains were consumed by children who ate family meals whilst watching TV compared with those who ate family meals without watching TV ($p < .001$ in boys and 0.020 in girls) Girls who ate family meals whilst watching TV ate more fried foods than girls who ate family meals without TV ($p < .001$). Not so significant effect for boys.
							daily ($p \leq .05$). Children from younger mothers, immigrants, smoking parents, and mothers whose self-perceived health was poor were more likely to eat meals and snacks in front of the TV, as well as those from low SE families and mothers with no high school diploma ($p \leq .05$). Watching TV for >3 hr/day was associated with meals or snacks in front of the TV ($p \leq .05$)

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Fitzpatrick et al., 2007 USA (22)	N = 1,336 parent-child pairs from low-income households. Children's ages ranged from 1.0 to 4.9 years; mean age was 2.8 years. Sample was evenly divided between males and females.	Cross-sectional study of care-givers participating in Women, Infants and Children (Food and Nutrition service) in New York state between May and Dec 2000.	Self-administered survey (available in English or Spanish)	Self-administered survey (available in English or Spanish)	Frequencies of serving fruits, vegetables, and milk	Race or ethnicity and parental education attainment	Number of days the TV was on during dinner was inversely associated with serving fruits (OR: 0.95, $p < .05$) and serving vegetables (OR: 0.94, $p < .01$). Number of days or week eating dinner as a family was positively associated with servings of fruit (OR: 1.14, $p < .001$) and vegetables (OR: 1.15, $p < .001$). However, having dinner as a family does not overcome the adverse effects of having the TV on during mealtimes.
Hare-Bruun et al., 2011 Denmark (25)	N = 697 8–10 year old (382 female and 315 male); N = 495 14–16 year old (275 female and 220 male) school children in Odense, Denmark.	Prospective cohort study with cross-sectional analysis (data from Danish part of European Youth Heart Study 1997–98 and 2003–2004)	Computer-based questionnaire developed for the EYHS	Computer-based questionnaire developed for the EYHS and 24-hour recall with qualitative food record completed at home, face-to-face.	Effect of TV viewing on healthy food preferences and healthy food habits.	Survey year, BMI z-score, physical activity, maternal BMI, paternal BMI, and SES.	More TV viewing was associated with lower healthy food preferences in all 8–10-year-old girls (OR: -0.61 for 1–2 hr/day and -1.06 for >2 hr/day, $p \leq .05$), and boys (OR -1.12 for 1–2 hr/day and -1.36 for >2 hr/day, $p \leq .001$) and in 14–16-year-old girls who watched >2 hr/day (OR: -0.94 , $p \leq .05$). Boys aged 8–10 years who watched TV during meals every day or most days had less healthy food preferences than those who rarely watched TV during meals (OR: -0.83 , $p \leq .05$). 8–10-year-old girls who watched TV during meals 1–2 times per week had higher healthy food

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Liang et al., 2009 Canada. (21)	N = 4,966 grade 5 students (predominantly 10–11 years old). (no detail on gender)	Data taken from 2003 children's lifestyle and school performance study, a population-based study of grade 5 students and their parents in Nova Scotia.	Questionnaire completed at home by parents, which collected information on sociodemographic factors and contained validated questions on their child's activities.	Slightly modified version of the Harvard youth/adolescent food frequency questionnaire.	Effect of watching TV and of watching TV whilst eating supper on percentage of students concerning two or more servings of soft drinks weekly, percentage of energy from sugar out of CHO energy, percentage of energy from dietary fat, percentage of energy from snack foods and prevalence of overweight.	Energy intake, child's gender, and household income	Eating supper whilst watching TV is negatively associated with diet quality (OR: -3.46 in those who watched TV during supper ≥ 5 times or week, 95% CI [-4.32, -2.60]) and positively associated with overweight (OR: 1.43 in highest quartile, 95% CI [1.14, 1.78]). TV watching showed positive associations with consumption of ≥ 2 weekly servings of soft drinks (OR: 2.46 in highest quartile, 95% CI [1.54, 3.93]), percentage of energy from CHO sugar (OR 1.21 in highest quartile, 95% CI [0.52, 1.89]), percentage of energy from snacks (OR: 2.20 in highest quartile, 95% CI [0.29, 4.10]), and percentage of overweight (OR: 2.42 in highest quartile, 95% CI [1.54, 3.79]). TV watching showed
							preferences than those who rarely watched TV during meals (OR: .068, $p \leq .05$). Watching TV during meals most days or every day was associated with less healthy food habits in 8–10-year-old girls (OR: -1.56, $p \leq .001$), 14–16-year-old girls (OR -1.24, $p \leq .001$), and boys age 14–16 years (OR -2.04, $p \leq .0001$)

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Lissner et al., 2012 Sweden (20) (IDEFICS data collected from: Italy, Estonia, Cyprus, Belgium, Sweden, Germany, Hungary, and Spain)	N = 15,144. IDEFICS data—children aged between 2 and 9, recruited via their daycare centres or schools. (N = 7436 females and 7708 males)	Baseline data collected between Sept 2007 and June 2008, taken from IDEFICS study (2-year intervention study)	Parent questionnaire about children's lifestyles, diets and family circumstances. Physical examination to characterise weight status and cardiometabolic health.	Children's eating habits questionnaire (CEHQ) comprising Food Frequency Questionnaire (FFQ) relating to previous 4 weeks	BMI, propensity to consume high fat or sugar foods, taste preference (sweet or fat)	Model 1: country, parental education (as a measure of SE status), age and sex Model 2: previous covariates, plus fat and sugar propensity ratios.	negative associations with daily servings of fruits and vegetables (OR: -0.08 in highest quartile, 95% CI [-0.19, 0.03]) and diet quality index (OR: -1.73 in highest quartile, 95% CI [-3.35, -0.10]). Effects of watching TV on percentage of energy from fat (OR: 0.17) and on diet quality index (-1.73) were less pronounced than those of supper in front of the TV on these nutritional indices (OR: 0.97 and -3.46, respectively).
							Eating whilst watching TV was associated with more high fat items (OR: 1.49 in highest quartile, CI: 1.34–1.65) and more high sugar items (OR: 1.93 in highest quartile, CI: 1.72–2.16) in proportion to total number of foods consumed. Eating whilst watching TV was significantly associated with overweight, with prevalence odds ratios of 1.20 for boys and 1.35 for girls (CI: 1.04–1.40 and 1.17–1.55, respectively). Watching 60 minutes or more of TV per day was associated with overweight with OR of 1.20 in boys (CI 1.05–1.38) and 1.21 in girls (CI: 1.06–1.38).

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Matheson et al., 2004. USA (24)	N = 90 third grade children aged 7.8–9.6 years (mean: 8.6 years) (N = 51 females and 39 males); N = 142 children aged 9.0 to 11.5 years (mean: 9.6 years) (N = 66 females and 76 males).	Baseline cross-sectional data collected in 1999–2000 from: Sample one: recruited from a school-based trial on reducing TV viewing. Sample two: drawn from a study of factors affecting children's dietary intake.	For each meal or snack children were asked whether they participated in any of the following activities whilst eating, watching TV, videotape, movie, played video games or on a computer, watched a movie at the theatre, did homework or reading or played inside or outside, were riding in a car van, bus or truck.	Three nonconsecutive dietary recalls, including two weekdays and one weekend day. The first recall was conducted face-to-face and the remaining two recalls were collected over the telephone.	Description of the amounts and types of foods that children consume whilst watching TV, compare those times with the types consumed at other times of the day, and examine association between BMI and amounts and types of foods consumed during TV viewing.	Two samples were analysed separately. Weekend and week day data calculated separately.	Amongst 3rd grade children who ate whilst watching TV on weekdays, 0.07 servings of soda were consumed with the TV on compared to 0.36 with the TV off, 0.05 servings of fast food were consumed with the TV on compared to 0.35 with the TV off and 0.09 servings of veg were consumed with the TV on compared to 0.73 with the TV off. Amongst 5th grade children who ate whilst watching TV on weekdays, 0.39 servings of veg were consumed with the TV on compared to 2.07 with the TV off and 0.15 servings of sweets and snacks were consumed with the TV on compared to 0.58 with the TV off. In the weekday 3rd grade data, the correlation between children's BMI and % energy from fat consumed during TV viewing was significant ($r = .025, p = .04$). In the 3rd grade sample, 59% of snacks were consumed during TV viewing on weekdays and 45% on weekends. In the 5th grade sample, 67% of snacks were consumed during TV viewing on weekdays and 45% on weekends. This was more frequent than meal consumption in front of

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Rey-López et al., 2011 (28)	N = 1,336 aged 12½ to 17½ years old. (N = 699 females and 637 males)	Data from HELENA cross-sectional study, collected Oct 2006–Dec 2007. Data selected that had valid information from the sedentary behaviour questionnaire and only data from Ghent, Heraklion, Pecs, and Zaragoza was included, because other cities that took part in the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) cross-sectional survey (CSS) did not examine food consumption during sedentary behaviours.	Self-reported sedentary behaviour questionnaire taken by the children at school, which included questions about habitual TV viewing time and concurrent food choices.	Self-reported sedentary behaviour questionnaire taken by the children at school, which included questions about habitual TV viewing time and concurrent food choices.		Family affluence, parental occupation, parental education	<p>the TV. More than one third of the children's dinners were consumed in front of the TV.</p> <p>Energy dense dietary choices during TV viewing were more likely in boys who watched TV >2 hr/day (OR: 1.88, 95%CI [1.15, 3.08]) and in girls who watched TV >2 hr/day (OR: 1.58, 95% CI [1.15, 2.17])</p> <p>Compared with boys who watched TV for ≤2 hr/day, boys who watched >2 hr/day had more frequent consumption of</p> <ul style="list-style-type: none"> • soft drinks ($p = .001$) • pastry ($p = .004$) • sandwiches ($p = .004$) • savoury ($p = .006$) • sweets ($p = .04$) <p>Compared with girls who watched TV for ≤2 hr/day, girls who watched >2 hr/d had more frequent consumption of</p> <ul style="list-style-type: none"> • fruit juice ($p = .02$) • soft drinks ($p = <.0001$) • beer ($p = .03$) • coffee ($p = .03$) • pastry ($p = .04$) • sweets ($p = <.0001$) • sandwiches ($p = .002$) <p>Girls whose mothers achieved a low educational level had an increased risk of consumption of energy-dense drinks during TV viewing (OR: 3.22, 95% CI [1.81, 5.72]) compared with those whose mothers attained the</p>

(Continues)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Verzeletti et al., 2009 Italy (29)	N = 14,407 adolescents between 11 and 16 years of age; N = 7,904 from Belgium (N = 3,991 females and 3,913 males); N = 6,503 from the Veneto region of Italy (N = 3253 females and 3250 males).	Cross-sectional study on data from the 2005–2006 HBSC survey.	Questionnaire with questions on family food rules and food-related family lifestyles.	Questionnaire with questions on family food rules and food-related family lifestyles.	Daily fruit and vegetable intake	SES	highest education. Girls with low family affluence status were more likely to consume energy-dense drinks during TV viewing; this association was less when paternal occupation and education were tested (OR: 2.03, 95% CI [1.19, 3.47]). After controlling for variables, there was no association between having a daily meal whilst watching TV and daily fruit and vegetable intake. Findings suggest that heavy TV viewing behaviours may be associated with lower fruit and vegetable intake among adolescents but also that the hours of TV viewing are more important than the habit of watching TV during meals for these outcome variables.

Note. BMI = body mass index; EYHS = European Youth Heart Study; HSBC = health behaviour in school-aged children survey; IDIFCS = identification and prevention of dietary- and lifestyle-induced health effects in childhood and infants; OR = odds ratio; SE = socioeconomic status; SSB = sugar-sweetened beverages; TV = television.

TABLE 3 Quality assessment scores using the Newcastle–Ottawa scale

Reference	Selection (max. 2*)	Comparability (max. 2*)	Outcome (max. 2*)
Carson & Janssen, 2012	**	**	*
Coon et al., 2001	**	**	*
Cox et al., 2012	**		*
Del Mar Bibiloni et al., 2009	**	**	*
Dubois et al., 2008	**	**	*
Feldman et al., 2007	**	**	*
Fitzpatrick et al., 2007	*	*	*
Hare-Bruun et al., 2011	**	**	*
Liang et al., 2009	**	**	*
Lissner et al., 2012	**	**	*
Matheson et al., 2004	**		*
Rey-López et al., 2011	**	**	*
Verzeletti et al., 2009	**	*	*

Eight of the 13 studies in Table 2 have been submitted for publication since 2009. The data were all collected after 1993 from developed countries including the USA, Canada, Australia, Spain (and Balearic Islands), Denmark, Italy, Estonia, Cyprus, Sweden, Belgium, Greece, Germany, Hungary, and Portugal. Six studies are based on data collected since 2005.

One study reported outcomes specifically for children from families of low SES (Fitzpatrick, Edmunds, & Dennison, 2007); only two studies (Cox et al., 2012; Matheson, Killen, Wang, Varady, & Robinson, 2004) did not take SES or some measure of it (e.g., parental education level or household income) into consideration when performing the statistical analysis.

3.3 | Eating whilst watching TV and food and drink consumption

Note. Only significant results ($p \leq .05$) are reported unless otherwise stated. All results are reported in chronological order, from preschool to adolescence

3.3.1 | Diet quality

Eight of the studies looked at aspects of diet quality. Cox et al. (2012) found a weak positive association between TV viewing and consumption of obesogenic ($r = 0.23$) and fast foods ($r = 0.27$) in preschool children. Children, (2–9 years), who ate whilst watching TV were found by Lissner et al. (2012) to have more high-fat and high-sugar items in the diet in proportion to total number of foods consumed, compared with children who did not eat whilst watching TV.

Two studies used a questionnaire to score the children's diets in order to determine an overall index of diet quality. Hare-Bruun et al. (2011) deduced scores based on tertiles of healthy eating according to consumption of foods containing fat, added sugar, and liquid sugar in order to score children on total healthy food preferences (Σ HFP) and total healthy food habits (Σ HFH). They found that boys aged 8–10 years who watched TV during meals every day or most days had less healthy food preferences than those who rarely watched TV during meals (Σ HFP: -0.84 , 95% confidence interval (CI) $[-1.52$,

$-0.16]$). Girls aged 8–10 years who watched TV during meals 1–2 times per week, however, had higher healthy food preferences than those who rarely watched TV during meals (Σ HFP: 0.68 , 95% CI $[0.06, 1.31]$). Regardless of their preferences, watching TV during meals most days or every day was associated with less healthy food habits in 8–10-year-old boys (Σ HFH: -2.25 , 95% CI $[-3.11, -1.40]$) and girls (Σ HFH: -1.56 , 95% CI $[-2.36, -0.76]$) and 14–16-year-old boys (Σ HFH -2.04 , 95% CI $[-3.12, -0.96]$) and girls (Σ HFH: -1.24 , 95% CI $[-2.16, -0.32]$). The findings of Liang et al. (2009) in 10–11 year olds were based on a food frequency questionnaire, which created a scale of diet quality based on consumption of soft drinks, energy from sugar, fat and snack foods, and daily servings of fruits and vegetables. A diet quality index was created as a composite measure, which encompassed dietary variety, adequacy, moderation, and balance. These results concur with those of Hare-Bruun et al. (2011), in that eating supper whilst watching TV is negatively associated with diet quality index, which decreased from 63.08 in children who had supper in front of the TV less than once per week to 60.12 in children who had supper in front of the TV ≥ 5 times per week.

Other studies looked at more specific aspects of the diet. Coon et al. (2001) found that “middle school” children who ate >2 meals or snacks per day with the TV on obtained 3% more of their total daily energy from pizza, salty snacks, and sodas than children who ate meals with the TV on ≤ 2 meals per day. Feldman, Eisenberg, Neumark-Sztainer, and Story (2007) identified an increased consumption of fried foods by adolescents who ate family meals with the TV on compared with those who did not (1.3 servings per day compared to 1.1 in girls and 0.54 compared to 0.49 in boys). Carson and Janssen (2012) observed an increase in junk food consumption, as defined by sweets (candy and chocolate), coke or other soft drinks-containing sugar, cakes, pastries or doughnuts, potato chips, or French fries, associated with more time spent eating whilst watching TV.

These findings were reinforced by Rey-López et al. (2011), who ascertained that energy dense dietary intake during TV viewing, mainly in the form of snacks, including soft drinks, pastry, sandwiches, and sweets, were more likely in adolescents who watched TV >2 hr per day. Boys consumed savoury snacks more frequently, whereas girls consumed fruit juice and coffee more frequently compared with adolescents of the same gender who watched ≤ 2 hr per day.

3.3.2 | Consumption of fruits and vegetables

Of the eight studies, which reported on consumption of fruits and vegetables, seven identified a negative association between eating whilst watching TV and consumption of fruits and vegetables. Cox et al. (2012) found a moderate negative association between TV viewing and daily servings of vegetables ($r = -.31$) in preschool children. This was confirmed by both Dubois et al. (2008), where eating dinner or snacks daily whilst watching TV, and Fitzpatrick et al. (2007) where the number of days the TV was on during dinner was associated with fewer servings of fruits and vegetables in this age group. Matheson et al. (2004) found that on weekdays, 5th grade students ate 0.39 servings of vegetables when the TV was on compared with 2.07 servings eaten by their peers with the TV off. This finding was reinforced by Liang et al. (2009), in their study of 5th grade students. Coon et al.

(2001) found that children who ate ≥ 2 meals or snacks per day with the TV on consumed 16% less fruit and vegetables, which equated to 2% less of their total daily energy from fruits, vegetables, and juices. Daily consumption of dinner or snacks whilst watching TV was found to be associated with 0.23 fewer servings of fruits and vegetables per day (Dubois et al., 2008). Feldman et al. (2007) identified the importance of family meals but found that even if adolescents eat with the family, having the TV on during mealtimes was associated with a reduction in the number of daily servings of vegetables and particularly in the number of servings of dark green or yellow vegetables per day. Only Verzeletti, Maes, Santinello, Baldassari, and Vereecken (2009) found no association between watching TV during daily meals and fruit and vegetable intake in adolescence, but this study was of low quality.

3.3.3 | Consumption of sugar-sweetened beverages (SSBs)

Four out of five studies, which reported on SSB consumption found a positive association between watching TV whilst eating and servings of SSBs.

Dubois et al. (2008) found that eating whilst watching TV was associated with significantly increased odds of drinking soft drinks daily, which was more than double in those who ate snacks whilst watching TV sometimes (odds ratio [OR]: 2.294) and more than tripled in preschool children who ate snacks whilst watching TV every day (OR: 3.568). They also found significant associations between total daily eating whilst watching TV and consumption of soft drinks. There was a 70% (95% CI [1.2, 2.4]) greater chance of daily soft drink consumption in children who ate whilst watching TV once a day, and an 83% (95% CI [1.2, 2.7]) greater chance in children who ate in front of the TV twice a day compared with preschoolers who ate in front of the TV less than once a day.

Coon et al. (2001) identified a 15% increase in consumption of SSBs by "middle school" children where the TV is on during ≥ 2 meals per day. In contrast, children of a similar age, who ate whilst watching TV on weekdays, consumed 0.07 servings of soda with the TV on compared to 0.36 with the TV off but with no adjustment for confounding factors (Matheson et al., 2004).

Older children who ate family meals with the TV on were found to drink a further 0.2 servings of soft drinks than those who ate family meals without the TV on (Hare-Bruun et al., 2011). Rey-López et al. (2011) found that 21% of boys and 12% of girls who watched TV for ≤ 2 hr drank soft drinks during TV viewing, compared to 27% and 18% who watched TV for > 2 hr per day.

3.3.4 | Consumption of caffeine

Only one study (Coon et al., 2001) looked specifically at caffeine consumption and found that children who ate ≥ 2 meals per day drank, on average, twice as much caffeine as those who ate < 2 meals per day with the TV on. This may or may not be attributed to an increased intake of caffeine-containing SSBs. Although Rey-López et al. (2011) did not look at caffeine specifically, they found that 4% of adolescents who watched TV for > 2 hr per day consumed coffee during TV viewing, compared to 3% of those who watched ≤ 2 hr per day. This figure, however, was only significant amongst girls.

3.3.5 | Consumption of carbohydrate and grains

Dubois et al. (2008) identified a slightly greater carbohydrate consumption by preschool children who ate snacks whilst watching TV every day compared with those who did not (213 g per day as opposed to 210 g per day), whereas Feldman et al. (2007) found that slightly fewer grains were consumed by adolescents who ate family meals whilst watching TV compared with those who ate family meals without TV (5.6 daily servings, as opposed to 5.9). This reduced number of grains in the diet of adolescents who ate family meals whilst watching TV may contribute to a diet with lower dietary fibre content.

3.3.6 | Consumption of protein

Three studies considered protein consumption. Preschool children who ate snacks whilst watching TV every day consumed less energy from protein compared with those who did not (14.4% vs. 15.1%; Dubois et al., 2008). This result is in contrast to the observation that 2% more energy from protein and 14% more meat was consumed by middle school children who frequently ate meals with TV on (Coon et al., 2001). Although eating meals in front of the TV leads to increased protein consumption with greater meat consumption in middle school children (Coon et al., 2001), adolescents who ate snacks whilst watching TV obtained less of their daily energy intake from protein (Feldman et al., 2007).

3.3.7 | Vitamins and minerals

Two studies examined vitamin and mineral intake. Coon et al. (2001) found no association between TV watching at mealtimes and vitamin or mineral intake, but Feldman et al. (2007) found that older children who ate family meals whilst watching ate fewer calcium-rich foods than children who ate family meals without TV. Although only the two studies report on micronutrients, the results suggest that micronutrient levels may reflect the lower diet quality of children who eat whilst watching TV.

3.3.8 | Secondary outcomes: Effects of eating whilst watching TV on BMI and obesity risk

Six studies reported on BMI. Four studies identified a significant positive association between eating whilst watching TV and children's BMI. Cox et al. (2012) identified a moderate positive association between TV viewing and energy intake whilst viewing (0.61 on weekdays and 0.50 at weekends) as well as a weak positive correlation between preschool children's BMI z-scores and energy intake whilst viewing (0.21 on weekdays and 0.22 at weekends). Dubois et al. (2008) found that preschoolers who ate dinner or snacks whilst watching TV at least once per day had a higher BMI (mean BMI 15.9) than children who ate dinner or snacks whilst watching TV less than once a day (mean BMI 15.7). Both Lissner et al. (2012) and Liang et al. (2009) identified positive associations between eating whilst watching TV and overweight. Lissner et al. (2012) calculated an OR for being overweight of 1.28 in 2–9 year olds who regularly ate food whilst watching TV (95% CI [1.16, 1.42]). This ratio was greater in girls (OR 1.35, 95% CI [1.17, 1.55]) than in boys (OR 1.20, 95% CI [1.04, 1.40]). Liang et al. (2009) found that 41.7% of 5th grade children who ate supper in front of the TV ≥ 5 times per week were overweight, compared with 30.6%

of children who ate supper in front of the TV less than once per week. Only one study found that TV snacking was negatively associated with BMI. For every 1 unit increase in the TV snacking scale, BMI z-scores decreased by 0.03 in this group of adolescents but BMI did increase with increased time spent watching TV (Carson & Janssen, 2012).

Although Del Mar Bibiloni et al. (2009) did report a positive association between adolescent BMI and distraction at mealtimes, the findings were not significantly different.

3.3.9 | Secondary outcomes: Role of parents

Fitzpatrick et al. (2007) found that the number of days that meals were eaten as a family was positively associated with servings of fruits and vegetables but that this does not overcome the adverse effects of having the TV on at mealtimes.

Adolescents who ate family meals whilst watching TV were noted to consume fewer vegetables including dark green or yellow vegetables, grains, and calcium-rich foods and more soft drinks than children who ate family meals without the TV on. Girls who ate family meals with the TV on also ate more fried foods than girls who did not.

3.3.10 | Secondary outcomes: Influence of SES

Likelihood of eating whilst watching TV was found by Dubois et al. (2008) to fall with increasing SES, with a significantly greater proportion of preschool children from low SES eating meals and snacks in front of the TV than children of parents with greater occupational prestige, education level, and financial situation. Of the children in quintile 1 (considered low SES), 19.8% ate their dinner (evening meal) in front of the TV every day, whereas only 5.2% of children from quintile 5 (considered high SES) ate dinner whilst watching TV on a daily basis. This difference was greater still when considering snacking, with 32% of children in quintile 1 eating snack foods in front of the TV every day, compared with 6.5% in quintile 5. Both breakfast and lunch followed the same trend, with likelihood of eating in front of the TV every day decreasing throughout the quintiles.

Coon et al. (2001) found that children were more likely to have the TV on if their parents had lower incomes. Single parent families and less-educated mothers were also more likely to have the TV on at mealtimes. They also found that the more knowledgeable parents were about nutrition, the less likely it was that the TV would be on at mealtimes.

Parental education was found by del Mar Bibiloni et al. (2009) to be a risk factor for obesity with an OR of 3.47 for adolescent boys of parents with low educational level, compared with those of parents with high educational level (95% CI [1.58, 7.62]). For girls, the OR was 3.29 (95% CI [1.38, 7.89]). Rey-López et al. (2011) also found that a low level of maternal education was associated with higher consumption of energy-dense drinks during TV viewing; however, this result was only apparent among adolescent girls, with an OR of 3.22 (95% CI [1.81, 5.72]) compared with girls whose parents achieved the highest level of education. The effect of family affluence also affected girls' consumption of energy-dense drinks during TV viewing, with children from families of low affluence more likely to consume energy-dense drinks than those from families of high affluence (OR 2.03, 95% CI [1.19, 3.47]).

3.3.11 | Secondary outcomes: Screen time and physical activity levels

Just the one study, Cox et al. (2012) identified weak but significant positive associations between both weekday and weekend TV viewing and number of minutes spent in sedentary activities in this preschool population ($r = 0.20$ and 0.22 , respectively, $p = .05$).

4 | DISCUSSION

This review has concentrated on the influences of watching TV, including commercial and noncommercial TV, videos, and DVDs, without differentiating between them. Previous studies have found that energy intake is greater during TV watching than during use of computers or video games for homework or leisure (Lyons, Tate, & Ward, 2013; Marsh, Mhurchu, Jiang, & Maddison, 2014).

The primary outcomes of this review are the associations observed between eating, either meals or snacks, whilst watching TV and children's diet quality, and the secondary outcomes consider BMI, the role of parents, socioeconomic influences, and physical activity levels. Although previous reviews have considered the effectiveness of reducing screen time in children and the influence of TV on obesity (Boulos et al., 2012), none have looked at how eating whilst viewing TV affects children's diet quality. For the discussion, and to support the conclusions, only results from the studies with a high quality rating (≥ 5), and where there have been adjustments made for some measure of SES, will be considered. Related observations are used to add context to the findings.

There are many aspects that contribute to diets of poorer quality, including eating patterns, increased consumption of foods and beverages perceived to be bad for health, such as those high in fat and sugar, often referred to as junk food, as well as decreased consumption of foods perceived to be good for health, such as vegetables and fruits.

This review found evidence that eating whilst watching TV on most or every day does lead to a reduced quality of the diet consumed and that there is an association between watching TV during meals or snacks and a greater intake of energy dense high-fat, high-sugar foods including pizza, fried foods, savoury snacks, junk foods, and sweet foods.

Based on the quality and size of the studies, the data presented on unhealthy food habits appears to confirm that, even from as young as 2 years, children who eat whilst watching TV are more likely to consume high-fat, high-sugar foods.

The benefits of fruits and vegetables in the diet are well documented (Slavin & Lloyd, 2012), and exposure at an early age is important to prevent selective eating in later years (Coulthard, Harris, & Fogel, 2014). However, this review strongly suggests that there is a negative association between eating whilst watching TV and the consumption of fruits and vegetables (Coon et al., 2001; Feldman et al., 2007; Dubois et al., 2008). Children, of all ages, are clearly not choosing fruits as regular snack items to consume whilst watching TV. These findings are consistent with other reports, which have found total TV viewing time to be negatively associated with fruit and vegetable consumption (Ramos, Costa, Araujo, Severo, & Lopes, 2013). Based on these findings the authors suggest that the family

food environment should include a fruit bowl or vegetable platter, full of attractive and varied fruits and vegetables, sited near to the TV.

The findings comparing carbohydrate and protein intakes suggest that TV “snackers” could represent a distinct population compared to those children who tend to eat meals in front of the TV, because many snacks are carbohydrate based compared to meals, which normally comprise a protein portion such as meat, but the age of the child may influence the results.

Previous research has focussed on the effects of TV on consumption of SSBs (Olafsdottir et al., 2014), and it was hypothesised that this review would support the existing evidence base that eating and drinking during TV increases consumption of SSBs, including sodas, fruit juices, and caffeine-containing SSBs. Indeed, the results are consistent with existing studies, and the findings add strength to the previously established association between screen time and SSBs by confirming a link between drinking SSBs, including fruit juice, during TV use and increased amount and/or frequency of consumption (Coon et al., 2001; Feldman et al., 2007; Dubois et al., 2008; Rey-López et al., 2011). Given that the consumption of SSBs in the USA has increased from 222 to 458 kcal per day over the past 3 decades (Duffey & Popkin, 2007), interventions, which aim to reduce the consumption of SSBs whilst watching TV, are important.

Overall, a positive correlation was seen between children's BMI z-scores and energy intake whilst viewing with the exception of some teenagers who may fill up on TV snacks with a lower energy content and then eat less at mealtimes. Although a secondary outcome, the general association between eating whilst watching TV and increased BMI adds context to the primary findings regarding children's diet quality. The size and quality of these studies adds to the previous evidence base linking TV with obesity.

The data reported confirm the important role of parents and the relevance of setting limits (Anderson & Whitaker, 2010), because increased energy intake and unhealthy eating or drinking habits are associated with increased screen time and eating whilst watching the TV. Parents are a strong influence on children's food choices in their early years of life, and it is known that girls are more likely to snack, including whilst watching TV, and to have increased screen viewing time if they come from overweight families (Falbe et al., 2013). Parents are responsible for setting a precedent for their children and are therefore influential in influencing screen-viewing habits and dietary choices. It appears that eating together as a family on a regular basis is associated with lower BMI and healthier food choices in children (Hammons & Fiese, 2011) but that, although family meals are important, they do not counteract the effects of watching TV whilst eating.

More children, of all age groups, from lower socioeconomic backgrounds consume snacks, energy dense drinks, and meals whilst watching TV compared with children from families with a higher level of income or educational attainment. This review implicates SES and measures of it as a major factor in children's TV eating and drinking habits. These secondary findings are supported by previous studies on the subject (Currie et al., 2012; Rollins, Belue, & Francis, 2010), highlighting the need for educational programmes aimed at parents, especially those with low socioeconomic backgrounds.

Previous studies have found that, although TV is associated with increased BMI, typically in a dose response manner, this relationship is not dependent upon physical activity (Brown, Nicholson, Broom, & Bittman, 2011; Laurson, Eisenmann, & Moore, 2008; Stamatakis et al., 2013). This review adds limited supporting evidence that the effects are not due to an increase in sedentary time replacing that which would otherwise be spent being physically active, but to changes in diet quality.

5 | STRENGTHS AND LIMITATIONS

All data is cross-sectional. Intervention trials would be necessary to confirm causality rather than the associations reported. However, the data are representative of the western world and collected from a wide range of developed, westernised countries. Some of the large sample sizes may have influenced the levels of significance reported although the high quality studies made adjustments for key confounders.

Although much research has been done to confirm that this association exists, this review is, to our knowledge, the first to collate evidence on the impact of eating whilst watching TV on children's diet quality, which clearly has an impact on weight status and health. We acknowledge that studies showing no association may not have been published. For us to further our understanding of this complex relationship between screen time and diet quality, future research should include interventions, which provide information about the possible underlying factors. For example, is there an element of convenience and eating food from packets rather than a plate or is it due to distraction and mindless eating, which affects diet quality if a child eats or drinks whilst watching TV? Such research would provide follow-up data to determine whether watching TV whilst eating as a child necessarily impacts on BMI and health in the long term and into adulthood.

Given the ever increasing number of “screens” being used by children, further research is required to determine the impact of different types of screen time, whilst eating, on diet quality.

Although the size of some of the associations may seem to be small, it is increasingly becoming recognised that the cumulative effect of small dietary changes may lead to significant nutritional improvements (Paineau et al., 2010), and a report prepared for a Joint Task Force including the American Society for Nutrition proposes that a small changes approach may help to address the obesity epidemic (Hill, 2009).

All dietary intake methodologies, for example, the use of food frequency questionnaires or dietary recall, have their limitations, which may lead to either incomplete or inaccurate reporting. Although the quality assessment did look for the use of validated tools, the limitations in the accuracy of dietary intake data may still be present even in high quality studies.

Overall, this review suggests that for children, from preschool age onwards, eating whilst watching TV reduces diet quality with more high-fat, high-sugar foods and fewer fruits and vegetables and increased consumption of sugar sweetened beverages. Although these differences in consumption tend to be small, the accumulative effect may be enough to cause the positive association between eating during TV use and prevalence of childhood obesity. It is recommended

that parents are targeted in any intervention, because their influence is vital in setting and enforcing limits on screen time, particularly whilst eating, and encouraging family meals without the TV on. Given that children from lower socioeconomic backgrounds are more likely to eat whilst watching TV, a focus on supporting these families to make changes is required in order to reverse the greater trends seen in obesity levels in children from families of low SES.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

AA, CA, and FM designed the study. CA led on the data extraction and data analysis with FM and AA agreeing on papers selected and data interpretation. CA prepared the first draft, and AA updated and prepared subsequent drafts, FM critically reviewed the manuscript.

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